



Sound Cost Estimating:

A Pre-Requisite to Ascertaining
Affordability of DoD Programs

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The guidance for achieving better buying power set forth in Dr. Carter's Sept. 14, 2010, memo requires action by every member of the acquisition community. This article considers just two of the many processes that are critical for program success: conducting a sound program life cycle cost estimate and establishing a program's budget. These two processes are interlinked in that the best available cost estimate should be used to determine the program budget, not only at major acquisition milestones, but also annually during the budgeting cycle. Interlinking of these processes is meant to ensure that the resources devoted to large programs are sufficient to complete them successfully, based on a comprehensive oversight process that includes scrutiny at least at major milestones as well as annual re-evaluations as part of DoD's budgeting process.

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Yet despite DoD's extensive oversight process and the best efforts of its workforce, the Department's acquisition programs are increasingly plagued by worsening cost and schedule growth and failure to deliver promised performance. While conducting sound estimates and appropriately establishing program budgets cannot ensure successful outcomes, they are two key processes that must be done right if a program is to have any chance of success.

Sound Cost Estimates

Conducting a sound cost estimate is a very difficult task. "It's tough to make predictions, especially about the future," has been variously attributed to Niels Bohr, Mark Twain and, of course, Yogi Berra. In his best-selling book *The Black Swan*, Nassim Taleb addresses humanity's horrible record of predicting the future, and particularly bemoans the fact that, because of our facility in inventing stories that convince us we understand the past, we unaccountably continue to believe we can predict the future well. He attributes our poor record in predicting to an inability to contemplate out-of-the-ordinary events, what he terms "Black Swans," referred to as "unknown unknowns" in military parlance.

So what's my point in quoting malapropisms about the future and describing unk-unks? Because it is important to recognize that a cost estimate is a prediction of the future, a bet on what we believe is going to happen. An estimate needs to be much more than just a set of numbers that are used to establish a program's budget. A good estimate provides decision makers with key insights into the risks (and opportunities) of a program. A broad explication of technical and schedule risks are sine qua non features of a sound estimate, but a really good estimate also specifically identifies key program risks. Examples include the validity of critical programmatic assumptions, appropriateness of the acquisition strategy, fluctuations in contractor business base, problems with outsourcing strategy or diminishing manufacturing/material sources, and other Black Swans that I haven't even thought of but that turn out (so obviously in hindsight!) to be important. It goes without saying that identifying all the key risks in advance is really hard.

Eminent statistician George Ball's quote about models aptly describes cost estimates: "All cost estimates are wrong; some are useful." This means that even though it's unrealistic to expect a program to cost exactly what is predicted, a good estimate has value in the information that it provides to decision makers. Besides identifying and providing insights into risks and opportunities, a sound estimate must also explicitly identify key cost drivers and quantify them to an appropriate degree of precision.

What is appropriate? In most cases, the distributions of an estimate (or distributions of the key cost drivers) presented to decision makers should be broader than those that have been proffered in the past. That is, historical data indicate that distributions of outcomes are broad compared to the distributions predicted in typical cost estimates.

So, while the bottom-line numbers given by a cost estimate are necessary to adequately resource a program, in my experience, the most important information that cost estimates provide senior decision makers are insights into the program's risks and cost drivers.

There are other crucial characteristics of a sound estimate that may not be explicitly considered by senior decision makers but need to be considered by the program manager and others charged with reviewing and assessing the estimate. These include the use of sound estimating practices and techniques, such as:

- **Using a variety of techniques to crosscheck results.** Ideally, data are derived from historical actuals that in all cases have been appropriately normalized and adapted so that the data are applicable to the program being costed (much easier said than done).
- **Incorporating all available, relevant information into the estimate when it is presented to decision makers.** This sounds obvious and straightforward, but again, it is easier said than done because of the long time frame required to produce an estimate and because estimates are sometimes structured in a way that makes it difficult to update them quickly.
- **Ensuring the estimate is robust.** For instance, it should provide the appropriate level of detail (which varies depending on the estimate's purpose); it should be created by personnel with sufficient expertise and experience to exercise judgment about the critical factors that influence the estimate; and ideally, it should be scrutinized and evaluated by independent, impartial experts. All these aspects require that appropriate time and manpower be allocated for the estimate.

PMs and others charged with evaluating an estimate should ensure that it:

- Provides explication of risks, both in a general and specific sense.
- Identifies and quantifies key drivers using sensitivity analyses to an appropriate degree depending on the purpose of the estimate and the time frame available for producing it.
- Is based on sound data that are appropriately relevant to the program under consideration.
- Takes into account the most recent information available on the program.
- Provides a sufficiently robust level of detail and has been independently scrutinized.

A PM has the ultimate responsibility to review and assess the validity of a program office's cost estimate and to present it to superiors in a balanced, responsible way. This is no small task, given the DoD and military culture of approaching all problems and issues with an optimistic, can-do attitude. Moreover, with more than enough to do, it is a natural tendency to believe good news about resolution of potential issues, whether it comes from contractors or program office subordinates. While

counterintuitive, devoting some time to continue to examine issues that are supposedly “on-track” is one strategy to provide early warning about problems before they become unmanageable.

A sound cost estimate is a necessary, but not sufficient condition in the process of providing a program with the resources necessary for it to be executed successfully. Ultimately, program success will depend more on the process the cost estimate is meant to inform, namely, establishing the program’s budget. Some of the reasons program budgets are often misaligned with the program’s best cost estimate are discussed below.

Misalignment Between Program Budgets and Cost Estimates

The DoD expends enormous effort and funds on program oversight. MDAPs are notorious in this regard, but indeed DoD programs at all levels are renowned for having an extraordinary amount of “red tape.” Given the huge effort and extensive deliberation associated with DoD’s Planning, Programming, Budgeting and Execution process, one would think that programs, after being approved for initiation and given a budget, would in general be adequately resourced to have a reasonable chance of success. Would that it were so! There are numerous reasons why a program’s established budget does not match the most reasonable expectation of what that program will most likely cost. Most disappointing are instances when decision makers should know that the program’s budget is likely to be inadequate, yet it is still underfunded during the PPBE process (see, for example, GAO-11-380R, the March 25, 2011, report on the Presidential Helicopter Program and other GAO reports on this program).

The full-funding requirement is meant to ensure that DoD programs have adequate resources budgeted currently and in the out-years to achieve their approved acquisition strategy. Full funding is a DODI 5000.02 regulatory requirement at milestones A, B, and C and is a statutory requirement as part of Title 10 Section 2366 certification at Milestone B. One would infer that programs should remain fully-funded throughout the acquisition process, with their budgets adjusted to reflect the

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latest best available cost estimate, but unfortunately that is often not the case. Until recently, there was little penalty for certifying a program as Fully-Funded at a major acquisition milestone and then cutting its budget during a subsequent budget cycle, sometimes even the cycle immediately following certification.

To be sure, sometimes the disconnect is the result of revised cost estimates that predict cost growth beyond the budgeted amount. Or the disconnect could result from poor program execution, either in terms of delivering what was promised or obligating and executing funds according to the planned timeline. However, programs executing successfully are also sub-

jected to budget cuts during the budgeting cycle of PPBE that cause them to be underfunded compared to the best available cost estimate, even when the DAE has directed budgeting to that estimate at the most recent milestone.

Structural reasons for this behavior abound: due to its insatiable appetite, the Department has more programs on-going than can be funded adequately (the “bow wave” problem); resource limitations lead some decision makers to rationalize that modest, recurring budget cuts drive efficiency by eliminating waste and non-value added work (when in fact they impair efficiency by subjecting the program to a “death of a thousand cuts”); and, the separate authorities and prerogatives of the requirements, acquisition, and PPBE communities mean that acquisition “decisions” are not necessarily resourced in the budgeting cycle. Finally, over-optimism can derail a program at any time from birth to infancy to adolescence—during the cost estimation process; during the milestone decision if a lower, optimistic cost estimate is selected as the basis for the APB; and during program execution, when our optimistic culture inhibits PMs and decision makers from recognizing and responding to problems that arise within programs.

The Expeditionary Fighting Vehicle (EFV), recently recommended for cancellation by then-Secretary Gates, is an instructive example of a program in which institutional failures related to cost estimating and resourcing occurred that in hindsight seem obvious. (As I also fall squarely into the trap identified by Taleb of inventing a story that perfectly explains

events—after the fact). Initial cost estimates for the SDD phase of the program in December 2000 at Milestone II by the Service and OSD/CAIG were \$0.86 billion and \$1.24 billion in base year 2007 dollars, respectively. The MDA elected to baseline the program based on the service cost position, which was considerably more optimistic than the CAIG's.

During the EFV's Nunn-McCurdy breach certification process in 2007, other estimating and resourcing shortcomings emerged that contributed to the program's cost growth and failure to meet KPPs. One was that the original cost estimates—both by the Service and the CAIG—were primarily based on analogies to the Bradley Infantry Fighting Vehicle and previous tank programs. The good news was that abundant cost data existed on those historical programs. The bad news was that the technological complexity of the EFV made these historical programs poor analogies, both for the RDT&E and the Procurement phases of the EFV program.

This is, unfortunately, a common problem cost estimators face when estimating revolutionary (vice evolutionary) programs, such as weapon systems that are invisible to the enemy, helicopters that can fly like aircraft, tanks that can ski across the water, and virtually all space and satellite programs. On the resourcing side, like many DoD programs, EFV suffered budget cuts that forced scaledown from the originally designed SDD program. Among the casualties of these budget cuts was a Reliability Improvement Program proposed by the contractor to improve subsystem reliability. Although failure to meet the reliability KPP threshold was the key cause of cost growth, which drove quantity reductions, which drove further cost growth and ultimately put EFV into a Nunn-McCurdy breach situation, it would be disingenuous to assert that better cost estimating and resourcing alone would have prevented program failure.

The oft-occurring bugaboos of technical immaturity and its corollary, over-optimistic timelines, are also cited by the GAO as contributing factors to EFV cost growth. Still, sound estimates and good resourcing are meant to take challenging timelines and the state of technology into account. So when a program fails, it is instructive to begin at the beginning and question the soundness of the estimate and the resourcing decisions, while heeding Taleb's admonition that stories we invent in hindsight that neatly explain events may not have been perceivable in advance.

Conclusion

So what can a PM do to improve the cost estimating and resource allocation processes for his or her program? At first blush, it seems like an insurmountable task, as cost estimates that established the program baseline may have been done years earlier and budget cuts are a systemic feature of our system. The advice I offer falls squarely into that common-sense, non-profound set of good management principles that all PMs are doing their best to adhere to every day. Be skeptical. Be transparent. Be resolute and courageous.

Be Skeptical

When evaluating your cost estimate, be skeptical in a big-picture sort of way. In other words: As PM you don't have the time or even necessarily the expertise to second-guess cost estimating techniques and methodologies or the accuracy and validity of data sources. But it is within your purview to create an environment in which key assumptions and even requirements are regularly re-evaluated to ensure they are still valid. They may have been valid at the time they were established. But conditions change, and sometimes requirements prove to be impossible to meet, and the sooner those changed conditions are recognized and dealt with, the better for your program. If you are lucky enough to be the PM at program initiation, wargame the cost estimate as if you're going into battle and your ASR depends on it. (Ok, APB is the better acronym, but I couldn't resist.)

Be Transparent

In all things, be transparent. Again, this is an obvious positive attribute, but here's what I mean in this context: When you become aware of issues that negatively affect your program's cost, rapidly gather the information, alternatives, and proposed solutions related to those issues so that your leadership and decision makers in charge of resources are informed as soon as possible. There is a tendency in our system to avoid surfacing a new cost estimate that predicts cost growth, particularly as the Nunn-McCurdy breach thresholds are approached. Do your best to ensure that program issues get timely attention, despite the delays inherent in our process.

Be Resolute and Courageous

Be resolute and courageous about the resources required for your program. I realize this is far easier to say than do, and the reality of our system is that PMs are expected to take their "fair share" of cuts and still do the job originally promised. Some people say it demonstrates a lack of credibility to say "If you cut my program by 5 percent, you might as well cancel it." My view, in contrast, is that it is in the best interest of the program and the DoD to quantify to the best degree possible the effect of cuts and change the program accordingly, whether that be by reducing requirements or by extending the program timeline, with the associated increased out-year expenditures that entails. And if a 5-percent cut in a program this year is going to result in a requirement for three times that amount of funds in the future (a conservative estimate!), those effects should be documented and provided to decision makers. To be sure, such an approach requires courage because it is a departure from how the Department has done business in the past, when cost growth was more or less accepted as part of the process. Our belated realization that affordability must be on an equal par with performance necessitates that we make changes to that past way of doing business, so that we produce affordable systems with acceptable rather than exquisite performance within reasonable timelines to support our warfighters.

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